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Installation and User Manual

PV Smart String Box active (with contactors)
SSB-A-14-140, SSB-A-25-250

Version 1.00

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Datasheet SOLO Smart String Box

Type	SSB-A-14-140	SSB-A-25-250

Electrical Data

Maximum operating voltage	U_{DC}	1000 VDC	
Maximum output current DC	I_{DCmax}	140 A	250 A
Maximum number PV entrances (strings)		14	25
Maximal input current DC per string	I_{STRmax}	10 A	
Possible PV-string fuses		4, 6, 8,16 A	
String current measurement range	I_{STR}	0.5 – 15 A	
Reverse string current measuring	$I_{STR\ rev}$	Yes	
Surge arrester		Type II	
State indication lamp on the door		Yes	
Test voltage		2.5 kV 50 Hz 1 min	
Auxiliary contacts surge arrester trip (potential free contact)		Yes	

Mechanical Data

Dimensions in mm	L x W x H	700 x 270 x 500	
Weight	m	26 kg	29 kg
Color		RAL 7035 (light grey)	
Enclosure material		Glass fiber reinforced polyester fiber	
Protection class according to EN 60529		IP55	
Impact strength according to EN 50102		IK10	
Max air humidity		95 %	
Ambient temperature range	T_{amb}	-20 °C ... +60 °C	
UV proof		Yes	
PV+ Connections outer diameter cable gland fastening torque nominal / maximal (strand wire cross-section)		4.5 - 10 mm 1.5 Nm / 1.8 Nm (0.5 - 10 mm^2)	
PV- Connections outer diameter cable gland spring terminals through type (strand wire cross-section)		4.5 - 10 mm 0.5 - 6 mm^2 (0.5 - 10 mm^2)	
Inverter connections outer diameter cable gland fastening torque nominal / maximal Cable lug size		22 - 32 mm 25 Nm M12	
PE connection outer diameter cable gland fastening torque nominal / maximal Cable lug size		7 - 13 mm 25 Nm M12	

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Datasheet SOLO Smart String Box

String Box Interface

Contactor control input	Digital input 230 Vac, active high 230 VAC +10%/-15%, 50 Hz ± 10 %, P_{max} = 30W
Feedback output	Normally closed contact when contactor is in active state and surge arrested is not damaged 24 Vac/dc (18V – 36V), 2A@30VDC
Signal connection outer diameter cable gland Spring terminals through type (strand wire cross-section) Signal cable	4.5mm – 10mm 0.5 – 6 mm^2 (0.5 – 10 mm^2) Numbers of cores: 5x1,5 mm^2 Colour coded (VDE0293-308) – green/yellow, blue, brown, black, grey ÖLFLEX®CLASSIC 135CH BK 0,6/1kV

String Box Monitor Interface

Power supply input	230 Vac (+10 % / -15 %), 50 Hz (±10 %), Fuse protected- 1,25A
String box ready feedback output	Normally closed contact when String box is ready Contact specification: 24 Vac/dc (18 – 36 V), 2 A @ 30 Vdc
Signal cable for power supply and ready feedback signal	Screened, UV light resistant, number of cores: 5x1,5 mm^2; Colour coded (VDE0293-308): green/yellow, blue, brown, black, grey; recommended: ÖLFLEX®CLASSIC 135CH BK 0,6/1kV, Lapp Kabel
Screw type separable terminals: Signal connection outer diameter (cable gland) Cable cross section	4.5 – 10 mm 0.5 – 2.5 mm^2
Fiber optical interface	Ring type serial interface connection
Cable type for glass fiber interface	Outdoor, UV light resistant, armoured Fibre type: Multimode 62,5/125 or 50/125 Cable end port ST type Recommended: A-VQ(BN)H 1x4, Corning Cable Systems
Terminals for glass fiber Signal connection outer diameter (cable gland)	ST port transmitter and receiver 4.5 – 10 mm
RS 485 serial interface	Galvanic isolated from monitor electronic. Separable screw terminal with. 6 pins for easy bus wiring
Cable type for RS485 interface	Outdoor, UV light resistant Recommended: UNITRONIC® Li2YCYv(TP) 2x2x0,5 or 3x2x0,5 (1 spare pare) , Lapp Kabel
Screw type separable terminals: Signal connection outer diameter (cable gland) Cable cross section	4.5 – 10 mm 0.5 – 1 mm^2

Options

Stainless steel enclosure
Fuses with light indication when tripped
PV – disconnect type terminals
Maximum operating voltage 1200 VDC

Standards

CE conformity / EMC	Yes / EN 61000-6-2, EN 61000-6-4 / EN 50178

1 Type code for PV Smart String Box

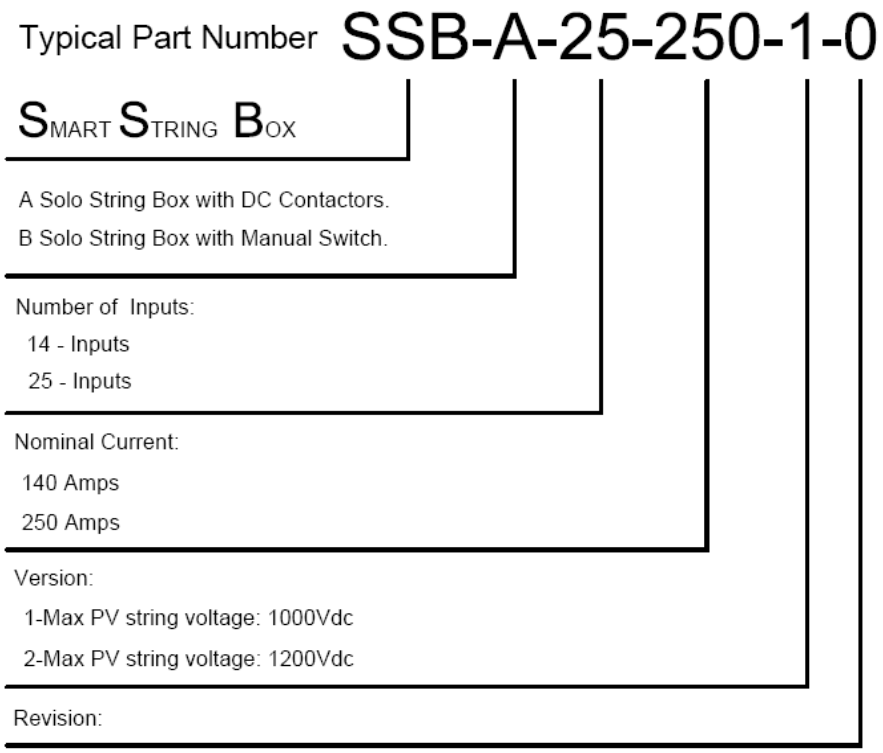

Figure 1 Type code for PV Smart String Box

2 Fuse selection guide

The fuse selection must follow the rules below:

- Maximum DC operating voltage of the fuse must be: 1.2 x nominal voltage of string
- Rated current of the fuse must be higher or equal than: 1.6 x I_{SC} (I_{SC} – short circuit current of panel)

I_{SC}, short circuit current of panel at STC, A	Rated current of the fuse, A	Size, mm	Pre-arching Joule integral [A^2s] L/R=2ms	Operating Joule integral [A^2s] L/R=2ms	IDS article number
≤2A	4A	10x38	3.3	28	ART-07020
≤3A	6A		5.5	45	ART-07021
≤5A	8A		8	62	ART-07022
≤8A	12A		35	270	ART-07023
≤10A	16A		35	270	ART-07023

Table 1

3 Introduction

The SOLO String Box is used to merge the electrical energy of the single PV module strings. Preferably the box should be placed close to the PV fields. The box is also used to disconnect the DC lines from the inverter. Several SOLO String Boxes can be connected in parallel to feed one tracker input of SOLO inverter.

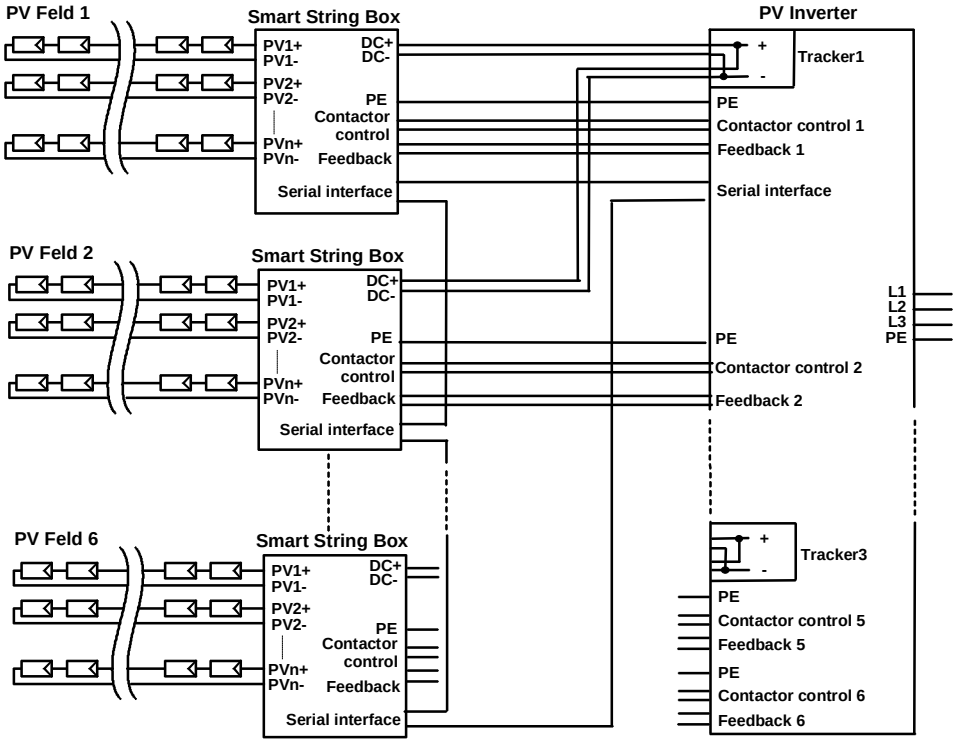

Figure 2 Exemplary overall scheme of a PV installation with Smart String Boxes

A different number of PV strings can be connected depending on the string box type.
The positive poles of the separate power feeds are protected individually, whereas the type of the fuses must correspond to the maximum PV module string current.
The separate string currents are guided together through coupling joints and contactors toward the two DC output terminals. The currents are monitored and via serial interface (fibre optical or RS 485) sent to the data collector, which can be a part of the inverter or a separate module.
If an overvoltage occurs the accruing energy is guided away toward the grounded potential thorough a surge arrester.

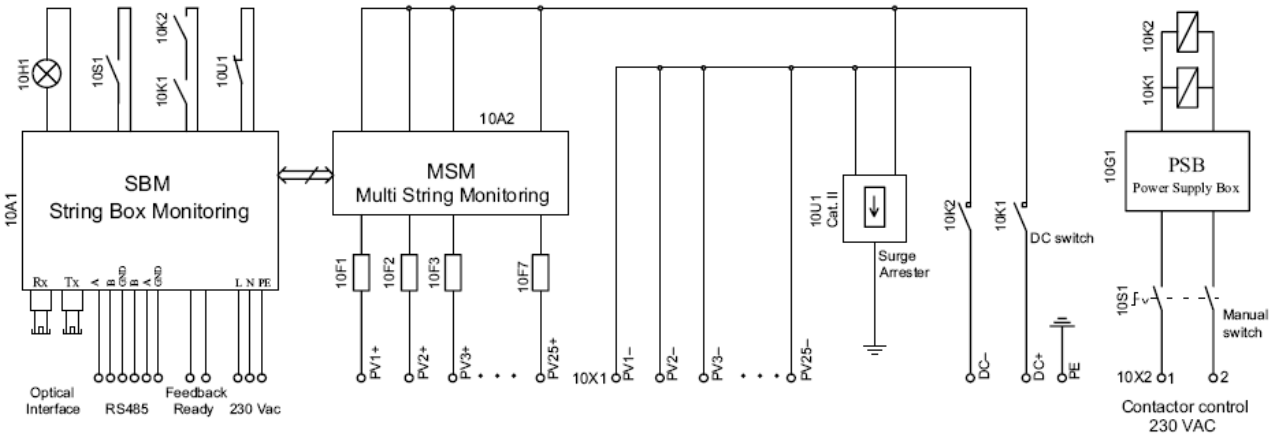

Figure 3 Scheme of the SOLO String Box with inputs for 25 PV strings

3.1 Disclaimer

The contents of the written text have been reviewed for compliance with the described hardware. However, inaccuracies cannot be excluded, thus preventing us from supplying a full guarantee for compliance. The data supplied in the current manual is reviewed regularly. Corrections are included in subsequent editions.
In case of violation of the installation instructions warranty claims will not be accepted.
We decline any liability in cases of accidents and material damage, caused by inappropriate handling, undertaking of works by unauthorized personnel and the resulting damages to persons and device, as well as for any subsequent damages.

3.2 General Safety Instructions

Photovoltaic installations operate with lethal voltages. The works described here should be performed only by authorized specialized personnel that are familiar with the installation, mounting, commissioning and operation of PV installation. This manual must be read and understood before the installation or the commissioning takes place.
Unauthorized personnel are not allowed to open the SOLO String Box.
The SOLO String Box may only be used for the envisaged purposes. The faultless and safe operation of the product assumes appropriate transport, specialized storage, installation and mounting as well as careful manipulation and maintenance.
The relevant regional and country-specific regulations and instructions must be obeyed. The requirements described, e.g. the placement location or the installation instructions (e.g. connection profiles, torques, etc.) must be taken under consideration at all costs.

3.3 Description of the Symbols and Warning Signs Used

	WARNING! The disobedience of this warning sign may lead to death or serious body injuries to persons.

	CAUTION! The disobedience of this warning sign could lead to property damage.

3.4 Scope of Delivery

Quantity	*Article*
1 pcs.	Smart String Box
2 pcs.	Plastic key for box opening
4 pcs.	Wall mounting kit

Table 2

3.5 Type Label

The type label with the product identification is located in the box on the right side under the protective cover as shown on *Figure 7*. The label is shown on *Figure 4*

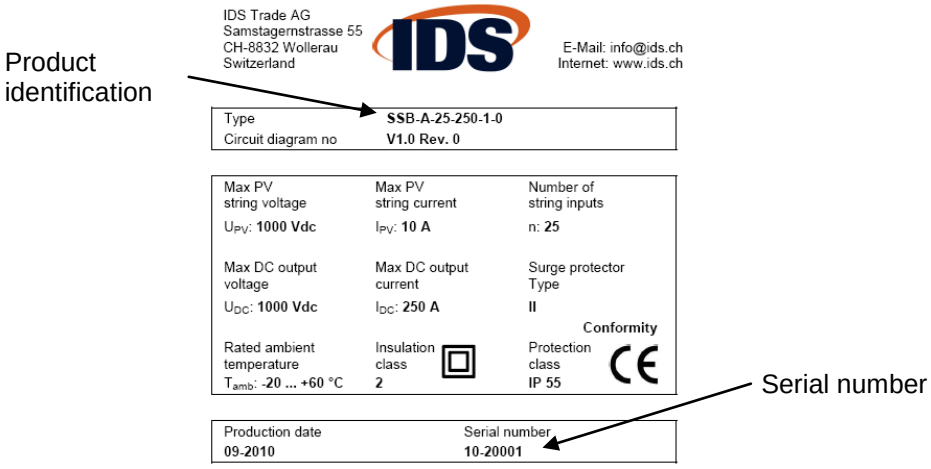

Figure 4 Example of a type label

4 Warnings

⚠	**WARNING!** The installation instruction must be obeyed, in particular the provisions for the installation of power current devices, for the electrical equipment of processing and manipulation machines, for the equipment of power current devices with electronic operation tools, as well as the regulations for the professional use of tools and personal protective equipment.

⚠	**WARNING!** The device must be installed, commissioned and maintained only by qualified personnel.

⚠	**WARNING!** The installation operates under life-threatening voltages. The PV module strings can be under voltage even when the SOLO String Box switch is turned off and the string protections are detached. The DC line toward the inverter can be under voltage even when the SOLO String Box switch is turned off. In addition, consider the discharge time of the inverter capacitors which is approximately 10 minutes!

⚠	**WARNING!** The SOLO String Box is a part of an entire PV installation. Therefore, please consider all warnings on the SOLO String Box and on the inverter! An automatic restart can take place after a network or photovoltaic voltage interruption.

5 Installation of the SOLO String Box

5.1 Opening the SOLO Box housing door

The SOLO String Box door is closed with the use of the supplied key.

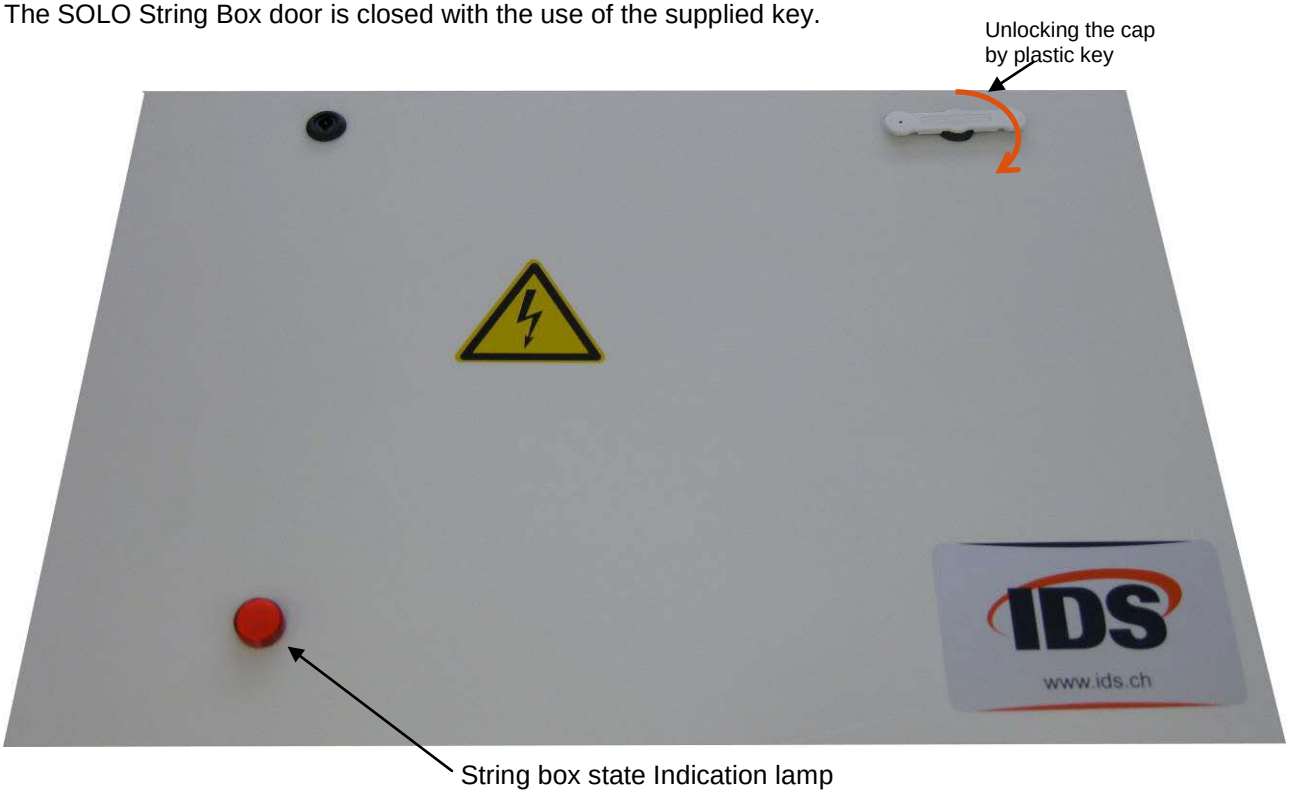

Figure 5 SOLO String Box housing door

5.2 Opening the SOLO Box protective cover

⚠	**WARNING!** Even if main switch is turned off the PV side and the DC output side might be under lethal DC voltage! Removing of this protective cover shall be done by authorized and qualified personnel only! Any liability is excluded in case this rule is not respected!

The protective cover of the SOLO String Box cannot be dismounted when the main switch is “on”.
In order to remove the protective cover please put the main switch in “off” position as shown on the *Figure 6*.
Then unlock the screws by slotted screw driver (1/4 revolution) as shown on the same picture.

Figure 6 SOLO Box protective cover

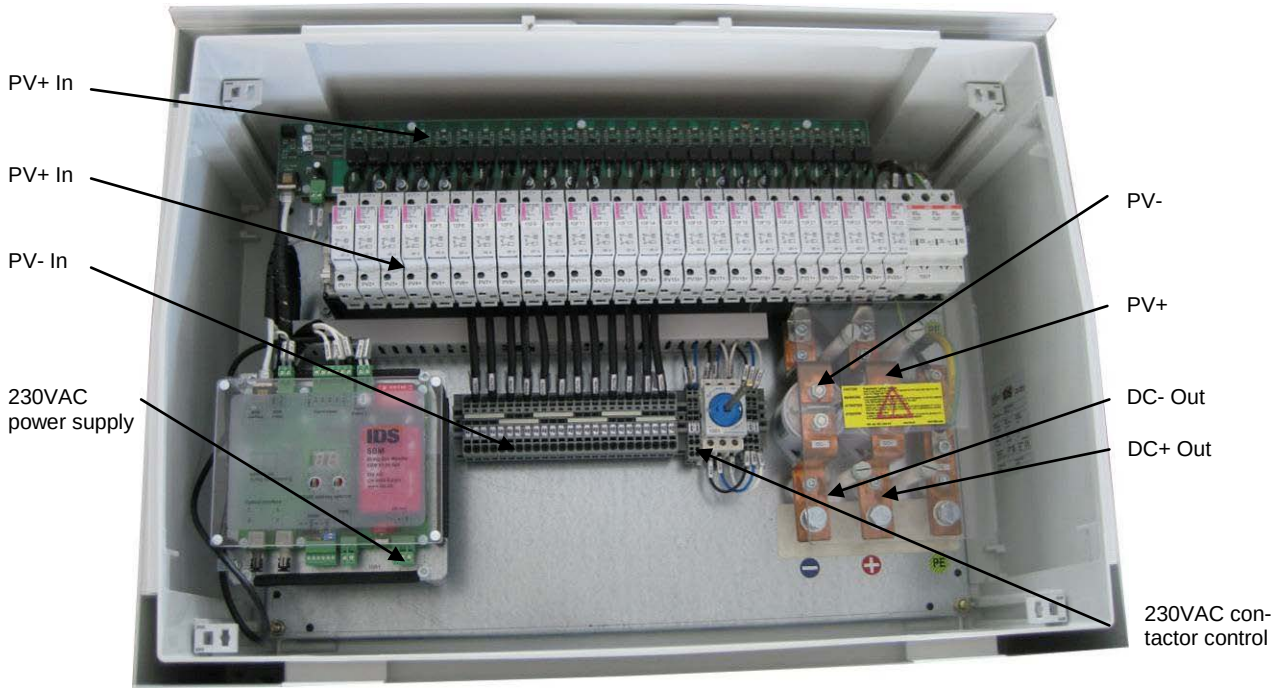

Figure 7 Inside view – Potentially lethal voltages location when main switch is off

5.3 SOLO String Box Design

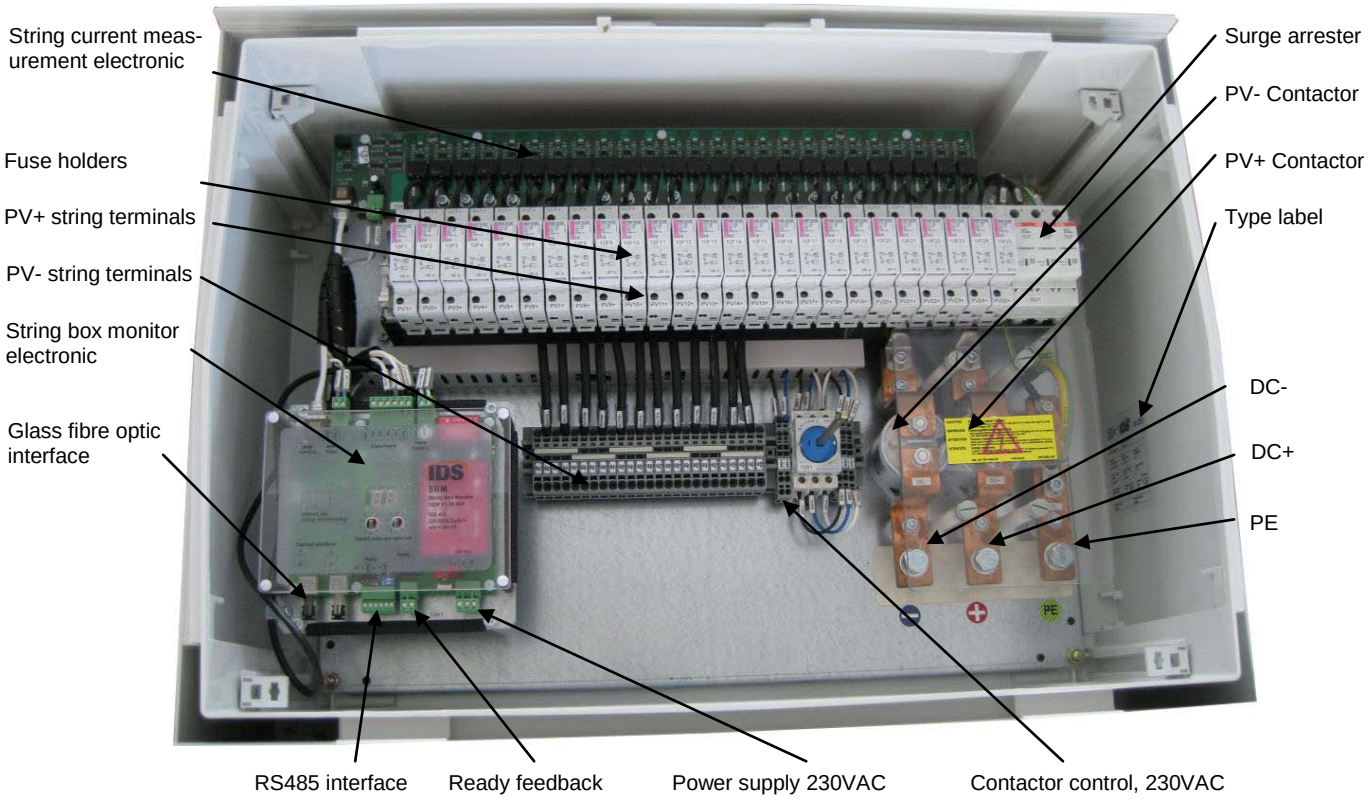

Figure 8 SOLO String Box (inside view)

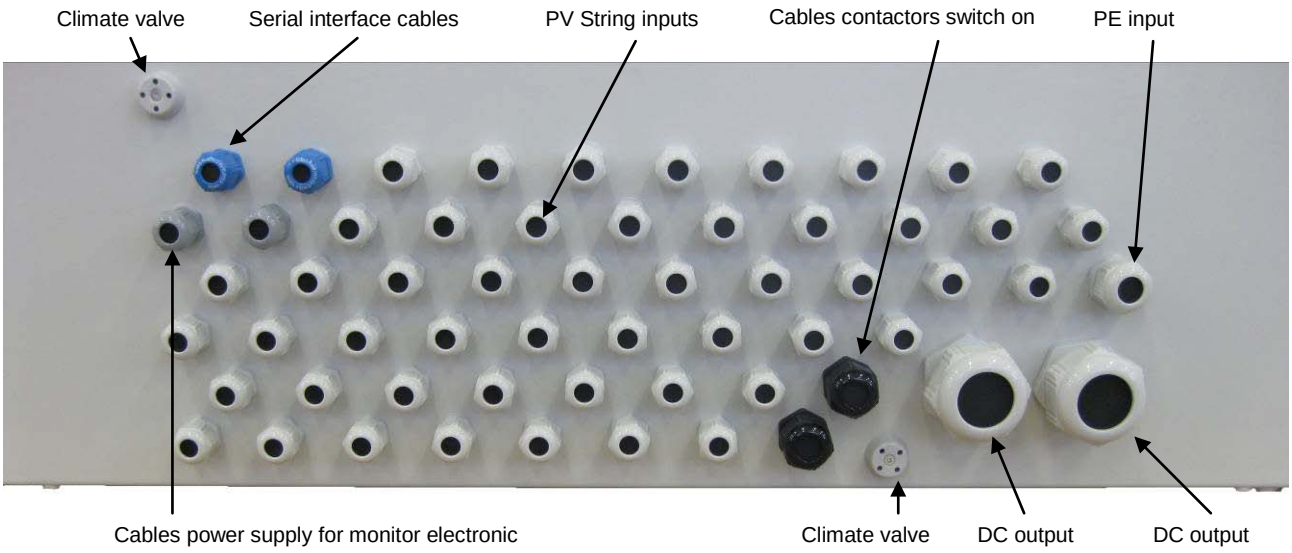

Figure 9 Cable glands on SOLO String Box (outside view)

Figure 10 Cable glands on SOLO String Box (inside view)

5.4 Location Choice

- The SOLO String Box is suitable for outdoor installation and should be placed as close as possible to the PV modules in order to minimize cable length.
- The Box should be freely accessible for maintenance work.
- A location without direct sunlight should be chosen.
- The SOLO String Box should be mounted in a way, minimizing or preventing the collection of water, dirt and moss development.

5.5 Mechanical Installation

- The supplied fitting materials should be used where possible.
- The SOLO String Box must be mounted vertically, with the cable holdings on the bottom side.
- Water must never reach the inside of the box!

The SOLO String Box should be mounted on a wall with the help of the supplied mounting clips.

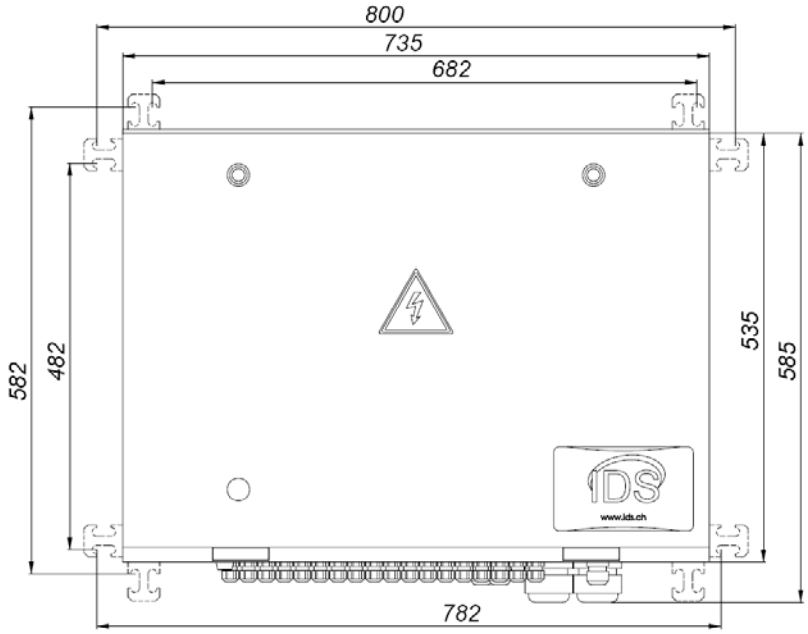

Figure 11 Dimension drawing SSB-A-14, SSB-A-25

The two climate valves, (see *Figure 12* front view and *Figure 13* rear view) must not be covered. They ensure the air circulation inside the SOLO String Box.

Figure 12 Climate valve inner view

Figure 13 Climate valve outer view

5.6 Electrical Installation

⚠	**CAUTION!** The works described may be executed only by electricians trained for PV installation.

⚠	**WARNING!** The PV module strings can be under voltage even when the SOLO String Box switch is turned off and the string protections are detached. The DC line toward the inverter can be under voltage even when the SOLO String Box switch is turned off. In addition, consider the discharge times of the inverter capacitors which is approximately 10 minutes!

⚠	**CAUTION!** The power supply lines must be mounted in a way that won't allow them to be damaged by rodents.

⚠	**CAUTION!** The electrical lines must not come in contact with flammable materials.

5.6.1 Electrical Connections of the PV Strings

⚠	**CAUTION!** Never feed a DC inlet with voltages higher than 1000V. Higher voltages lead to Box damages. In case of breach of this rule all warranties will expire and no liability for consequential damages will be undertaken.

The PV module strings must be connected to the dedicated terminals in the SOLO String Box. The correct polarity must be observed during this procedure. In case of incorrect polarity the SOLO String Box and the PV modules might be damaged! The connecting points are visible in the following pictures:

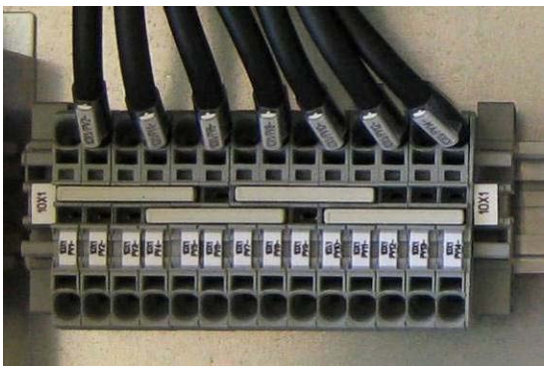

Figure 14 PV minus string terminals

Figure 15 PV minus string terminals disconnect type

Figure 16 PV plus string connections

5.6.2 Fuse Selection

The fuses are pre-installed at factory according to the SOLO String Box type. The fuses have to be selected according to Table 1 (Fuse Type Selection).

5.6.3 Power Cable Connections from Inverter to SOLO String Box

For installation, the protective transparent plate must be unscrewed and detached from the box.

First, the PE cable must be connected with a cable lug to the foreseen screw joint.

The supply cables from the inverter (*Figure 17*) are connected with cable lugs to the foreseen screw joints. The correct polarity must be observed!

The protective transparent plate must be mounted back and screwed!

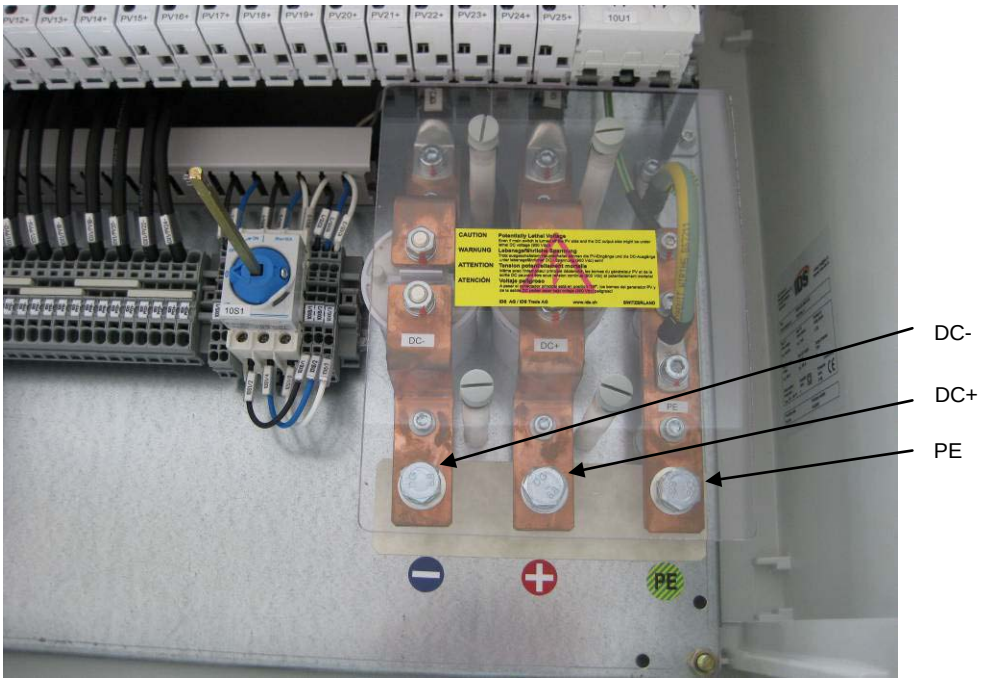

Figure 17 Connection of PE, DC+ and DC- output to the inverter

5.6.4 **Connection of String box Control Line to Inverter**

The connection of DC+ and DC- terminals to PV+ and PV- string joints is done by two contactors 10K1 and 10K2 respectively. They are switched on by 230VAC control line from inverter connected to control terminals 10X2/1 and 10X2/2 as shown on *Figure 18*.

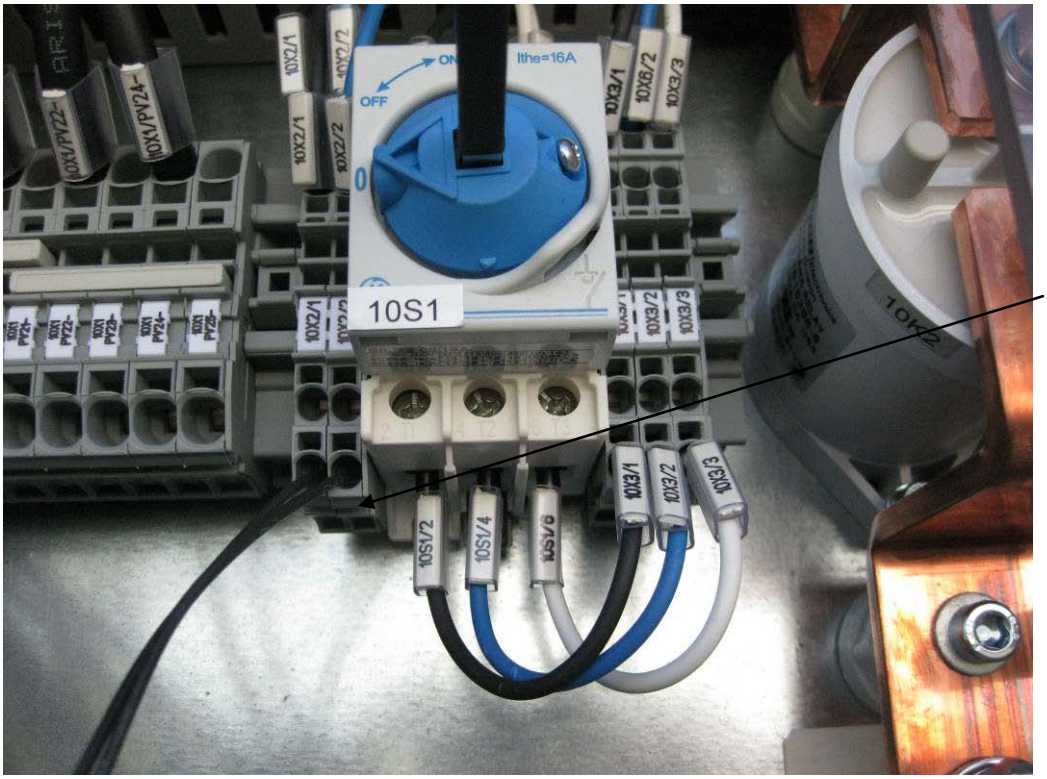

Figure 18 Connection terminals to signal cables

Note: Cable type recommended ÖLFLEX®CLASSIC 135CH BK 0,6/1kV

5.6.5 Connection of String Box Monitor Ready Feedback line and Power Supply

The surge arrester and the contactors are monitored by auxiliary potential free contacts.
The String Box Ready Feedback line is a relay dry contact activated depending on the state of the main switch, contactors feedbacks and surge arresters feedback.
The first one is the Surge Arrester signal contact. In case the signalling contact is open the surge arrester must be replaced.
The second and third contacts in the feedback line are the signal contacts of contactors -10K1 and -10K2. Each contactor has one power contact and one signal contact. Both contacts are open when the contactor is not supplied and closed when supplied.
The String Box Ready Feedback line must be connected through String Box Monitor(SBM) electronic ready terminals to inverter as shown on *Figure 19*.

Figure 19 Signal cable wiring – String Box Ready connection to the inverter

Figure 20 Signal cable wiring – String Box Monitor electronic power supply

Note: Signal cable type recommended ÖLFLEX®CLASSIC 135CH BK 0,6/1kV

5.6.6 Connection of String Box Monitor serial interface

The String Box Monitor serial interface can be realized by RS 485 electrical bus or fibre optical interface. In case of fibre optical interface is selected, it should be realized a ring between the data logger and string boxes. Starting from data logger the ring should go from box to box following the address selected order.

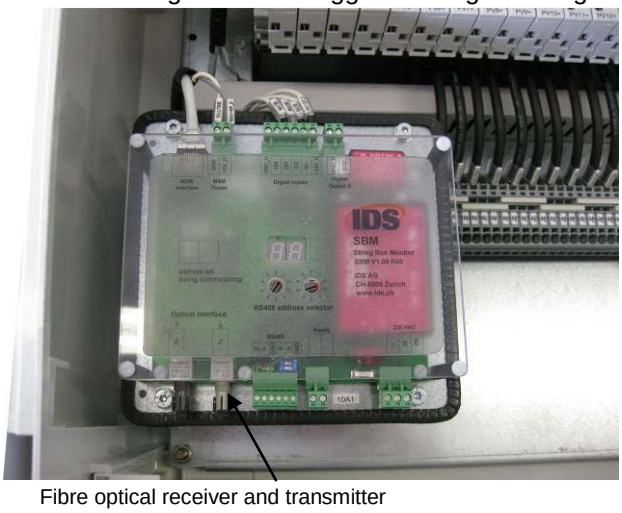

Figure 21 String Box Monitor fibre optical interface

Figure 22 String Box Monitor RS485 interface

6 SOLO String Box Commissioning

6.1 String Box Address Selection

All String Boxes connected to a common serial interface should have unique addresses. With the two installed address selection keys it is possible to address up to 100 string boxes in one bus. The selected address number is indicated by the help also of LED seven segment indicators, *Figure 23*. The two empty rectangulars on left side (label on *Figure 23*) are to write in with permanent marker the selected address during commisioning.

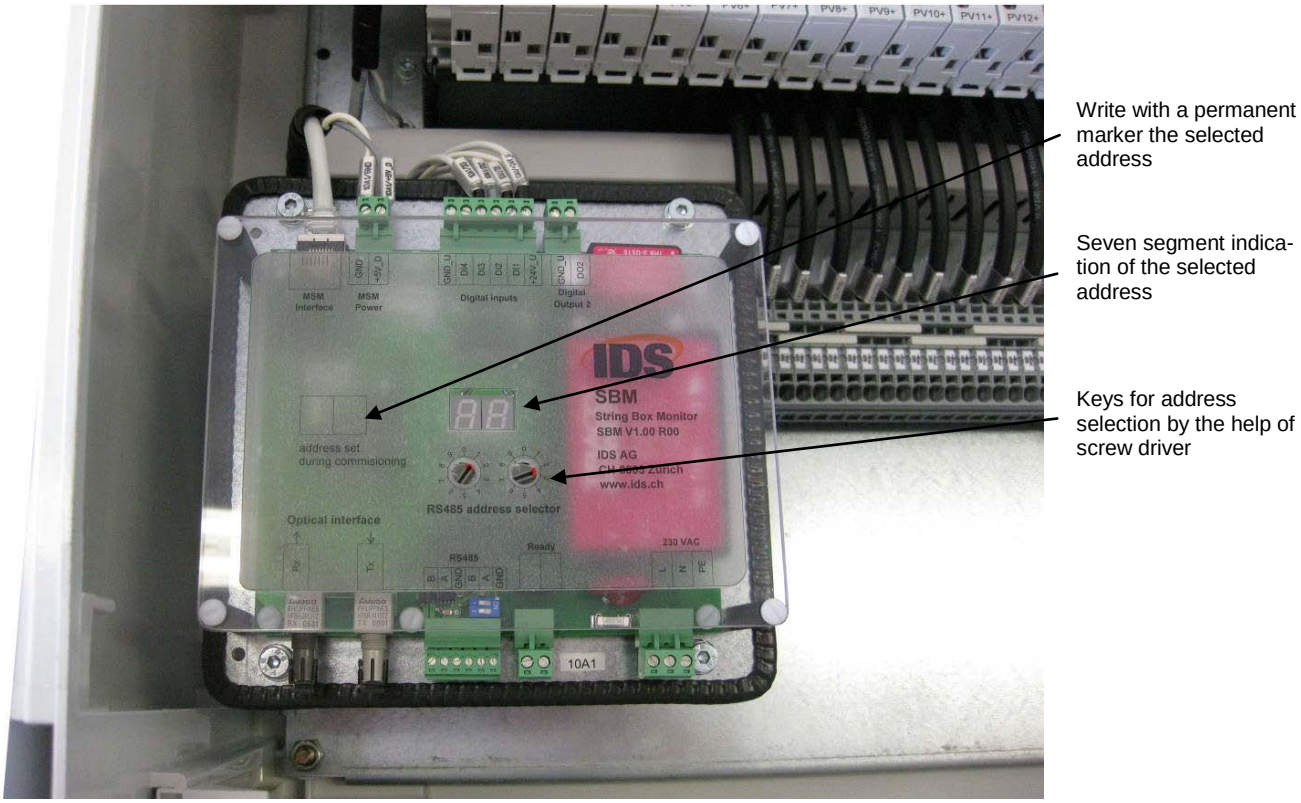

Figure 23 Setting the address of the String Box Monitor unit

6.2 Turning the SOLO String Box On

Make sure that the PV strings, DC+, DC-, signal and PE cables are installed correctly in the SOLO String Box.
Check if the fuse links sizes are rated for the correct current. The fuse rating must comply with the rules defined in Chapter 2 - Fuse selection guide.

⚠	**WARNING!** A wrong size of the fuse link can lead to damages both to the SOLO String Box and the PV strings.

⚠	**WARNING!** Danger of an electric shock Mount the plastic protective cover for protection against direct contact before proceeding with the commissioning.

The protective cover of the SOLO String Box can be dismounted or mounted only when the main switch is turned off (*Figure 24*).

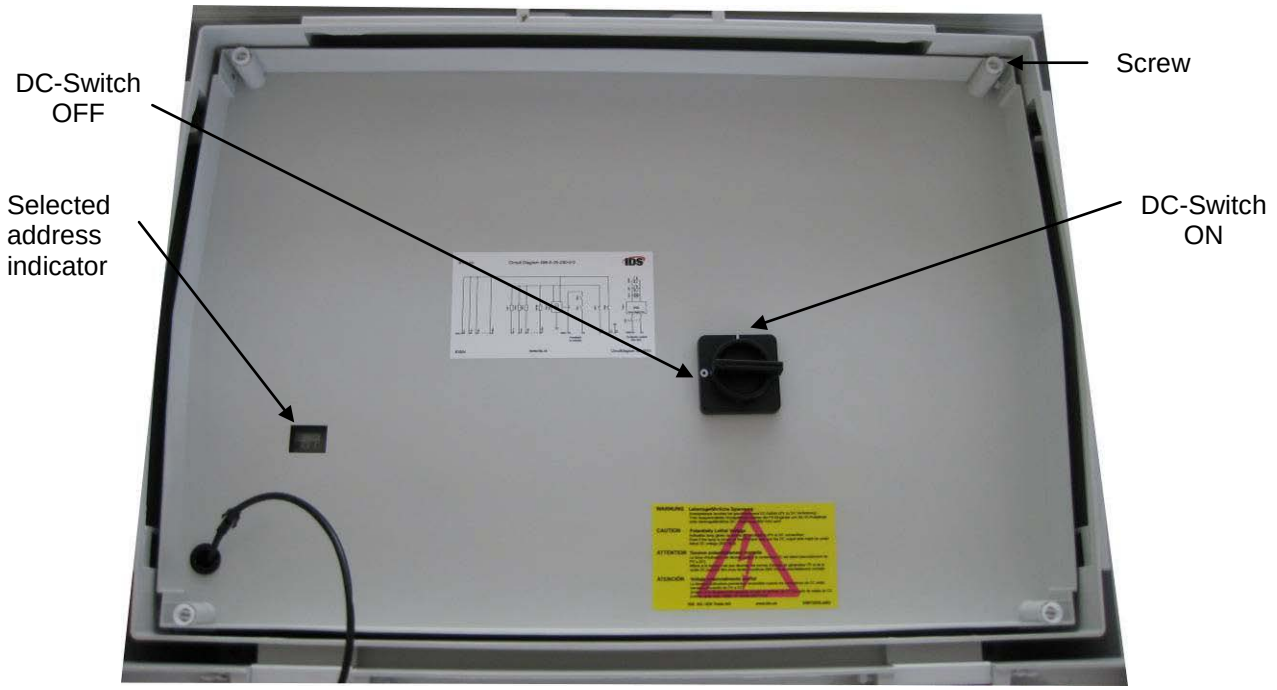

Figure 24 Protective cover

The screws of the SOLO String Box protective cover can be locked with the use of a slotted screwdriver, with a quarter of a revolution clockwise.

When the PV modules in the PV installation are connected properly, the SOLO String Box is ready for operation. For the commissioning of the SOLO String Box, please observe also the instructions described in the user manual of the photovoltaic inverter.
To connect the PV modules to the photovoltaic inverter, turn the main switch to “ON” position.

Close and lock the SOLO String Box door. The indication lamp on the door should glow with red light.
If the lamp is blinking this is an indication for a surge arrester or contactors or monitor electronic fault.

!	**CAUTION!** The door must be closed properly in order to prevent penetration of dust and humidity.

!	**CAUTION!** Contaminations on the rubber seal must be avoided at any cost. Damaged rubber seals must be replaced immediately.

6.3 Turning the SOLO String Box Off

In order to separate the PV modules from a photovoltaic inverter, turn the main switch in the “Off” position.

!	**CAUTION!** Please observe the instructions supplied in the user manual of your photovoltaic inverter.

6.4 Replacing Defective Fuse Links and Surge Arresters

⚠	**CAUTION!** The works described below may be executed only by electricians trained for PV installation.

⚠	**CAUTION!** Use only original fuses. In case of use of products manufactured and offered by third parties the protection of the installation will no longer be secured.

⚠	**WARNING!** The PV module strings can be under voltage even when the SOLO String Box switch is turned off. The DC line toward the inverter can be under voltage even when the SOLO String Box switch is turned off. In addition, consider the discharge times of the inverter capacitors which is approximately 10 minutes!

6.4.1 Replacing a Fuse

- Check through the data logger interface which string is not producing current. This can be an indication of a damaged fuse.
- Open the String box door.
- Turn the main switch to “Off”.

⚠	**CAUTION!** Please observe the instructions supplied in the user manual of your photovoltaic inverter.

- Replace the fuse link by pulling out the string fuse insert.
- Replace the fuse link with the correct rated current complying with the rules defined in Chapter 2 - Fuse selection guide.
- Close the string fuse insert.
- Put the protective cover.
- Turn the main switch on. The string is operational again.
- Close and lock the String box door.

Figure 25 Image of an open fuse link

⚠	**WARNING!** A wrong size of the fuse link can lead to damages both to the SOLO String Box and the PV strings.

6.4.2 **Changing a Surge Arrester**

The green indicator of the surge arrester will change its colour to red when it tripped.

Figure 26 Image of a damaged surge arrester

The surge arrester is monitored by auxiliary potential free contacts.

⚠	**CAUTION!** The works described below must be executed only by electricians trained for PV installation.

- Open the SOLO String Box door.
- Turn the main switch off.
- Unscrew and dismantle the protective cover of the SOLO String Box

⚠	**WARNING!** The PV module strings can be under voltage even when the SOLO String Box switch is turned off. The DC line toward the inverter can be under voltage even when the SOLO String Box switch is turned off. In addition, consider the discharge times of the inverter capacitors which is approximately 10 minutes!

- Remove the defective surge arrester(s) through pulling it out of the fuse holder and place a new one.

Figure 27 Removing of a damaged surge arrester

- Put the protective cover.
- Turn the main switch on.
- Close and lock the String box door.

7 Declaration of Conformity

EG – Konformitätserklärung
EC – Declaration of Conformity

Hersteller / *Manufacturer*

IDS Trade AG
Samstagernstrasse 55
CH-8832 Wollerau / Schweiz

Diese Konformitätserklärung bezieht sich auf die Anschlusskästen:
This declaration of conformity relates to string boxes:

SSB-A-14-140
SSB-A-25-250

Das bezeichnete Produkt stimmt mit den Vorschriften folgender Richtlinien überein:
The above described product is in conformity with the requirements laid down in the following guidelines:

EN 61000-6-2	Elektromagnetische Verträglichkeit (EMV) Teil 6-2: Fachgrundnormen - Störfestigkeit für Industriebereich (IEC 61000-6-2:1999, modifiziert) *Electromagnetic compatibility (EMC)* *Part 6-2: Generic standards - Immunity for industrial environments* *(IEC 61000-6-2:1999, modified)*
EN 61000-6-4	Elektromagnetische Verträglichkeit (EMV) Teil 6-4: Fachgrundnormen - Störaussendung für Industriebereiche (IEC 61000-6-4:2006) *Electromagnetic compatibility (EMC)* *Part 6-4: Generic standards - Emission standard for industrial environments* *(IEC 61000-6-4:2006)*
EN 50178	Ausrüstung von Starkstromanlagen mit elektronischen Betriebsmitteln; EN 50178:1997 *Electronic equipment for use in power installations; EN 50178:1997*

Aussteller / *issued by* M. Vinzens, CTO, IDS Trade AG

Diese Erklärung bescheinigt die Übereinstimmung mit den Richtlinien, beinhaltet jedoch keine Zusicherung von Eigenschaften.
Die Sicherheitshinweise der mitgelieferten Produktdokumentation sind zu beachten.
This declaration confirms the compliance with the quoted directive, but it does not constitute any warranty as to properties.
The safety information contained in the product documentation supplied must be adhered to.

Zürich, 21.10.2010

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M. Vinzens, IDS Trade AG

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